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The Spanish Wind Power Cluster

Final Report

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Microeconomics of Competitiveness
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COUNTRY ANALYSIS

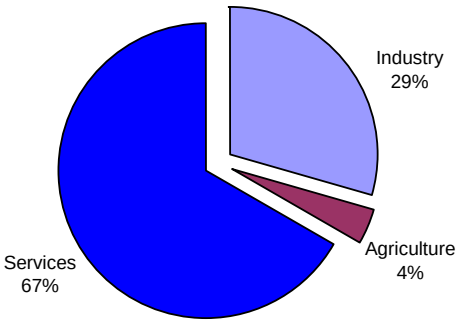
I. INTRODUCTION

Figure 1: Spain's Geographic Location

Spain has been a constitutional monarchy since 1978. Previously, Spain had suffered a devastating three-year civil war followed by 36 years of dictatorship under General Francisco Franco.

Located in Southwestern Europe, Spain's territory is somewhat smaller than France and slightly bigger than California. The country is home to 40 million Spaniards, 8.9% of the EU-25 population. Spain is the fifth largest economy in Europe. In 1986 Spain joined the European Community (EC) and was a founder member of the Economic and Monetary Union in 1999.

Figure 2: Spain's GDP by Sector



Source: WDI database (2006)

Spain's GDP per capita reached 29,044 USD in 2004, 96% of the EU-15 average. The Spanish economy is mainly driven by the service sector which accounts for 67% of GDP and 64% of employment. The main industries are tourism (the second largest tourism market in the world), textiles and apparel, food and beverages, metals and metal manufactures, chemicals, shipbuilding, automobiles and machine tools.

Spain is one of the most decentralized countries in Europe. However demands for greater autonomy by some of the seventeen regions or autonomous communities are often source of political tension. This highly decentralized regional structure has given the autonomous communities increased competence in education, health and public finances.

Spain has one of the lowest fertility rates in the world with 1.2 children born per woman. However, the long stagnating population trend has recently been reversed by increased immigration,

mostly from Latin America (39%), Eastern Europe (16%) and North Africa (15%). In 2005, Spain carried out a 3-month amnesty program which resulted in over 600,000 undocumented immigrants being granted legal residency. Over the past seven years, Spain has received more immigrants than any other European country. This unique demographic phenomenon has increased foreign immigrants from a 2% share of the population in 1998 to an 8.5% share in 2005. Immigrants are often employed in labor-intensive and low-productivity jobs, especially in the informal economy.

Spain geographic position is noteworthy for two reasons. First, the country offers global leverage into other Spanish-speaking markets, such as Latin America, based on its historical ties and cultural bonds. In addition, Spain is located on Europe's southernmost border, offering Europe the proximity to North Africa.

The Spanish Socialist Worker's Party (PSOE) won the March 2004 elections and selected the first Spanish government to have the same number of male and female ministers. Previously the conservative People's Party (PP) had rule for over eight years and had set economic liberalization at the top of the political agenda. In contrast, Rodriguez Zapatero of the PSOE has focused its three years in government on the political and social agenda: civil war remembrance, peace negotiations with the Basque terrorist organization, homosexual marriage and greater devolution to the Autonomous Communities. Economic reforms such as the labor market reform seem to lag behind.

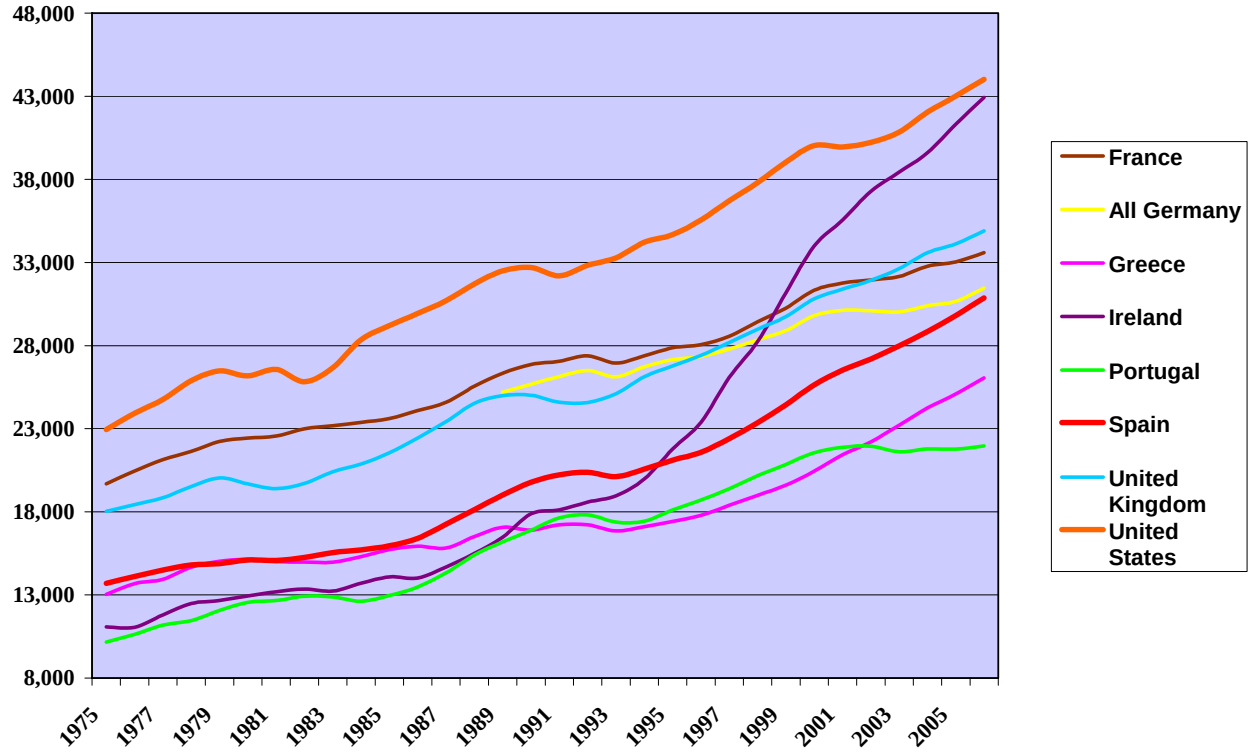
II. NATIONAL ECONOMIC PERFORMANCE

Although Spain was a latecomer to economic and industrial modernization, the Spanish economy has recently led an extraordinary process of convergence with Western Europe. In 20 years, Spain has closed the wealth gap with Europe's richest countries, with per capita income growing by 20 points to reach 96% of EU-15 average (see Figure 3).

Accession to the EC was a driving force in Spain that facilitated the conversion of the Spanish economy. Consistent with EC membership, Spain had to adapt the *acquis communautaire*

that required profound economic reforms: trade liberalization and the later adoption of the single market, implementation of the Common Agriculture Policy, macro-economic reforms derived from the European Monetary Union, etc. Spain benefited extensively from European Funds: during 20 years Spain received over €150 billion from the "structural and cohesion funds" and invested these funds in regional development, infrastructure, training and agriculture. By and large, the economic and social results of these developments have been extremely beneficial for Spain.

Figure 3: GDP per Capita for Spain, Western Europe and the U.S, PPP Adjusted US$

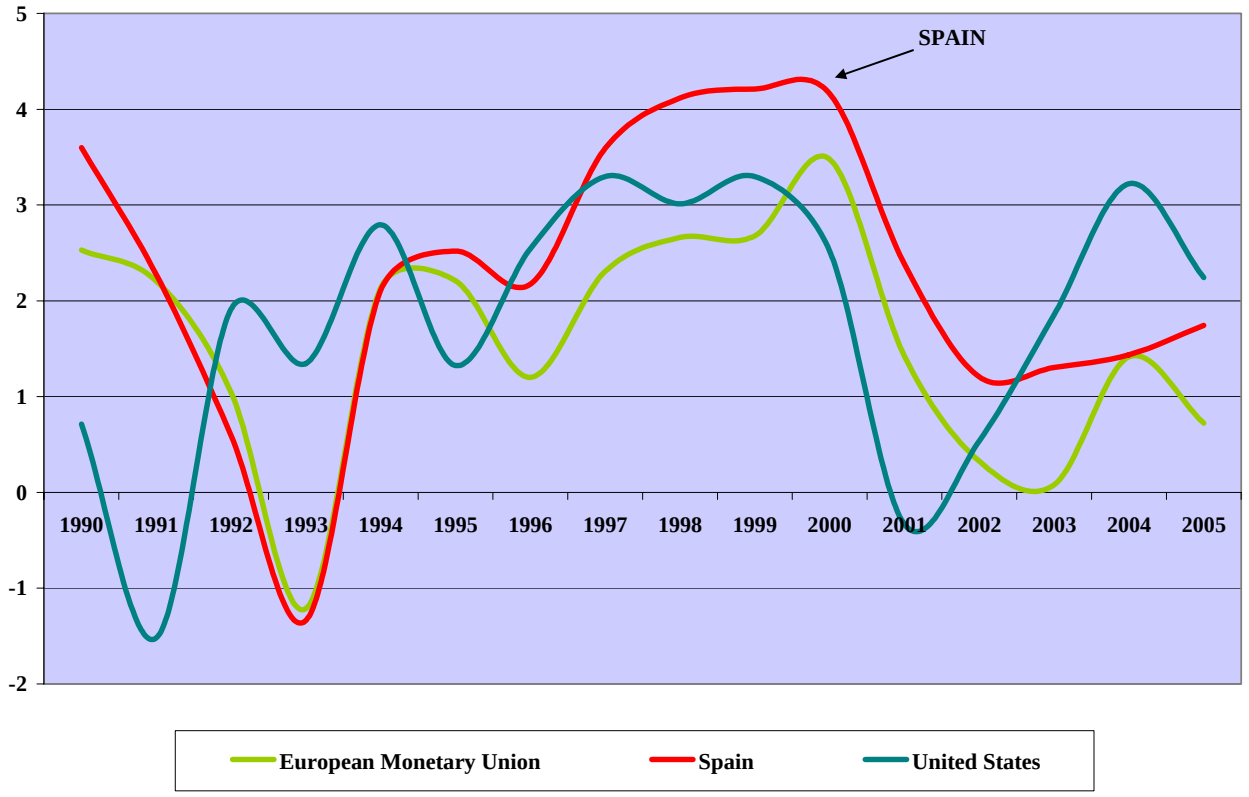


Source: Groningen Growth and Development Centre, 60-Industry Database (2005)

During this extraordinary process of convergence, Spain's economy grew faster than its European peers (see Figure 4). From 1986 to 1990 the economy averaged an impressive 5% annual growth. This economic boom was followed by a European-wide recession in the early 1990s that resumed in 1994. Since 1996, Spain has grown on average by 1.4 percentage points more than the EU average. Spain's macroeconomic performance is remarkable; in 2006 with an estimated 3¾ per

cent economic growth, the country will have experienced 13 years of strong, consecutive growth. The Spanish economy has thus been regarded lately as one of the most dynamic within the EU.

Figure 4: Annual real GDP growth for Spain, E.M.U. and U.S. (1990-2005)



Source: Groningen Growth and Development Centre, 60-Industry Database (2005)

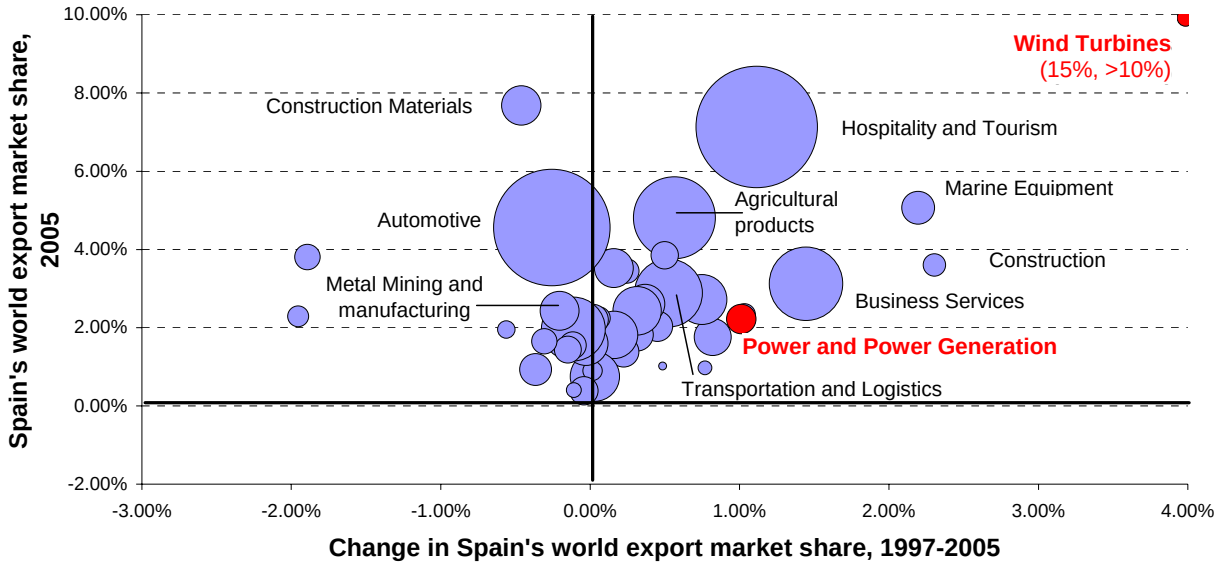
In the past decade, the convergence process has not been driven by higher labor productivity, but rather by increasing the participation rate through a reduction in unemployment to 8¼ per cent (from 19% in 1994) and the increased incorporation of female workers into the labor market.

III. EXPORT PERFORMANCE

Spain's export performance over the past decade has been impressive with multiple clusters gaining world market share (see chart below). Manufacturing based clusters, such as automotive, have struggled vis-à-vis Eastern European and Asian based producers. As we will see in the

following section, this is symptomatic of a relative loss of competitiveness, particularly in terms of labor costs. In this context, the "wind turbines" cluster has fared remarkably well with double digit growth rates and sizeable gains in world export market share.

Figure 5: Cluster Export Portfolio, 1997-2005



Source: Institute for Strategy and Competitiveness, Authors' Estimates

IV. STRATEGIC ISSUES FACING SPAIN

Although Spain's economic performance has been impressive, it faces significant challenges from both external and internal factors.

IV a. External factors:

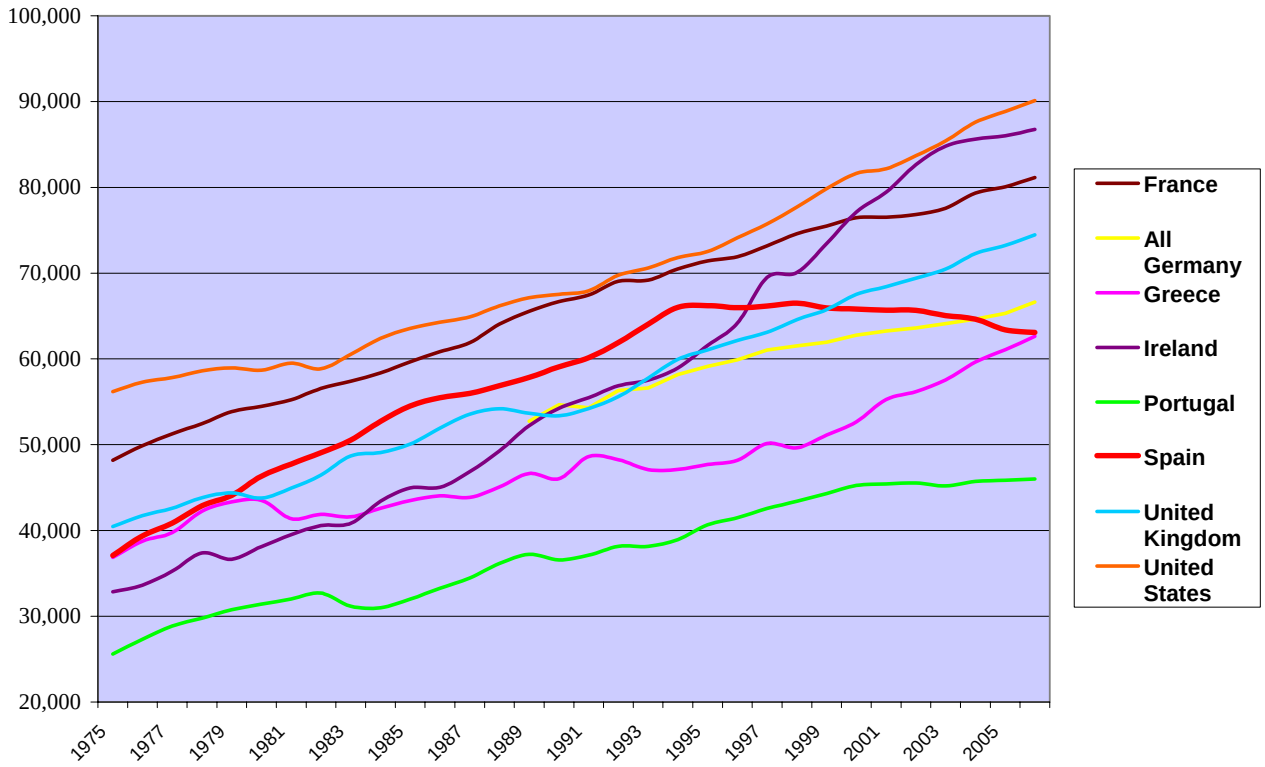
- *New competition from "within":* Since the accession of a number of Eastern and Central European states into the EU, Spain can no longer claim to be the low cost producer in Europe (labor costs are 20-60% higher than Eastern Europe). This negatively affects firms' profitability as well as investment decisions in labor intensive and low to medium technology products such as: machinery, electrical equipment, textile and automobiles – sectors that make up a large proportion of Spanish trade.

- *Globalization*: In addition, Spain, like most other developed economies, has to adjust to a sharp rise in exports from the Far East and Latin America.
- *Reduced EU Funds:* Spain has for years been a principal beneficiary of the EU's structural and cohesion funding in an attempt to reduce economic disparities with the rest of Europe. Given its economic convergence with the EU, such funding has declined in recent years to less than 1% of GDP in 2006 (Royo, 2006).

IV b. Internal factors:

- *Low productivity*: Spain's labor productivity performance in recent years has been underwhelming – a 2.2 point decrease over the 2000-04 period. As seen in Figure 6, GDP per person employed has stagnated since 1994.
- *Current-account deficit*: The lack of competitiveness and low savings rate has resulted in a record trade deficit. Spain current-account deficit reached 8% GDP in 2006 (EIU, 2007) – the highest in the industrialized world. Such a rapid buildup of net foreign liabilities will place a significant financial burden on the economy in the longer run.
- *Real estate boom:* Construction represented almost 17% of GDP in 2006, compared to 13.5% during the 1985-95 period. Concurrently, the level of indebtedness of Spanish families has grown from 60% of disposable income in 1990 to over 110% in 2006.

Figure 6: GDP per Person Employed in Spain, Europe the U.S. (PPP Adjusted US$)



Source: WDI database (2006)

V. SOURCES OF GROWTH

Figure 7: 2005 Employment Rates

Region	% of Total Population	
Spain (1995)	48.1	
Spain	64.7	*up 16.6%*
EU15	67.7	

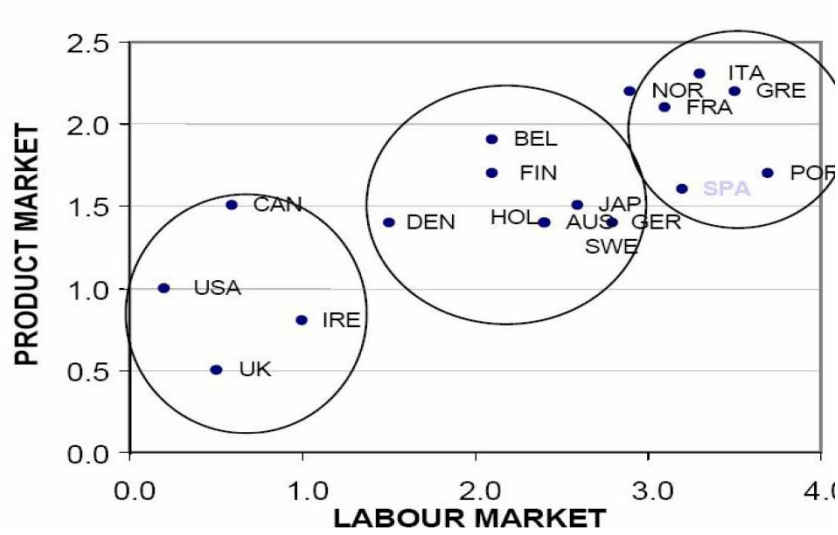
Source: OECD Economic Survey Spain (2007)

Spain's growth over the past decade has been driven a more intensive use of labor such as immigrants and women (see table). The increase in labor input is not expected to continue over medium or long term.

If such a scenario were to occur, Spain could experience a drop in growth potential, possibly reversing the economic convergence process (OECD, 2007). To avoid this, Spain must address the root causes of its poor productivity performance:

- *R&D Expenditures*: Low research intensity (1.05% of GDP, half OECD average) and weak technology adoption. Private sector R&D investment is particularly low due to the country's industrial structure and a smaller proportion of large firms.
- *Education*: University level education is lagging in international rankings and the country only invests 52% of the European average in job training.
- *Market Regulation*: Despite recent improvements introduced in the context of the *Lisbon Agenda*, it remains more restrictive than most European countries.
- *Labor Market*: Labor markets among the most rigid in the OECD (see Figure 8) has resulted in firms relying heavily on temporary employment to avoid the high social charges and dismissal costs associated with permanent workers. Over 60% of the jobs created over the past decade came in the form of temporary contracts. Temporary work however limits the incentives for the employers (and employees) to invest in training with negative consequences on productivity.

Figure 8: Index of Product and Labor Market Regulation

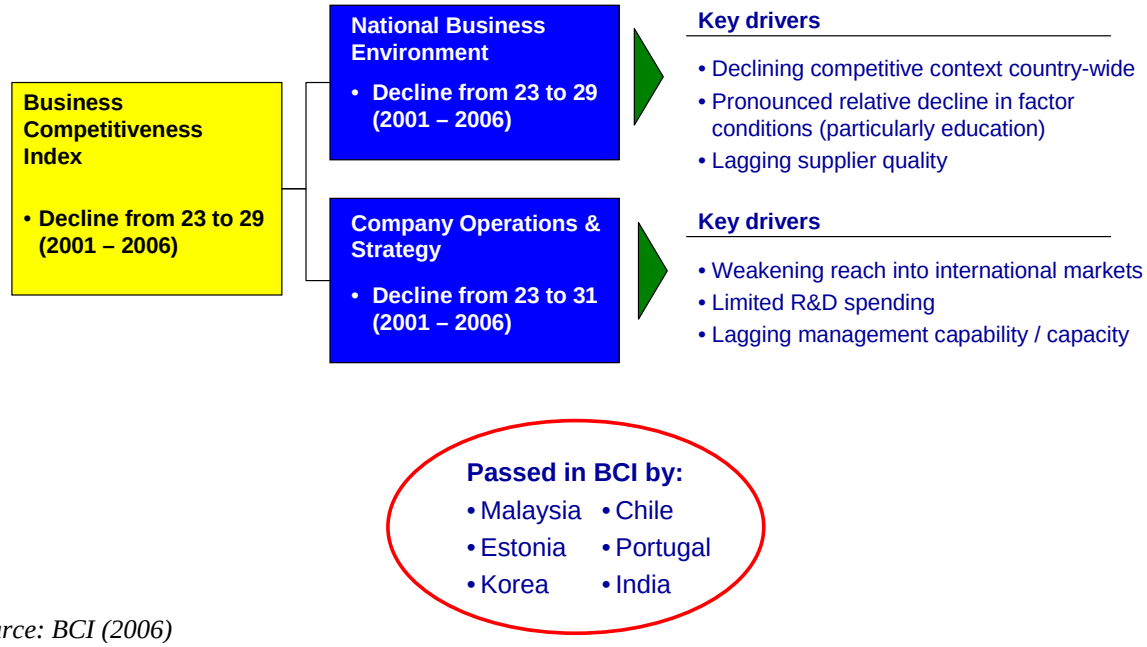


Source: OECD, Economic Survey: Spain (2007)

VI. SPAIN'S COMPETITIVENESS POSITION

Spain's overall competitiveness position has deteriorated over the last five years, resulting in a fall in the BCI rankings from 23 in 2001 to 29 in 2006. In part, this downward trend reflects the rising expectations of business operators in Spain. The Business Competitiveness Index arguably now holds Spain to the same standard as other western European countries. However, the country has also failed to sustain its position due to weaknesses in both its National Business Environment and Company Operations and Strategy.

Figure 9: Spain's Competitiveness Rankings



Source: BCI (2006)

VI a. Company Operations and Strategy (COS)

Spanish firms' operations and strategy has seen a marked turn for the worse over the last five years. This can be attributed to several key drivers (detailed in the table below):

- *Management:* Several indicators show a decline in Spain's relative competitiveness in corporate management, including "reliance on professional management" and "willingness to delegate authority."

- *Marketing***:** While some sectors, such as banking, telecoms, and even electric utilities have shown great ability to internationalize, the corporate sector as a whole has remained somewhat cloistered.
- *Innovation* **–** Finally, as discussed above, Spain's innovative capabilities have also lagged. While the "foreign technology licensing" indicator is strong relative to its GDP per capita position, Spain's ranking for in-country R&D spending has fallen considerably.

Figure 10: Change in Company Operations and Strategy Rankings 2006 vs 2001

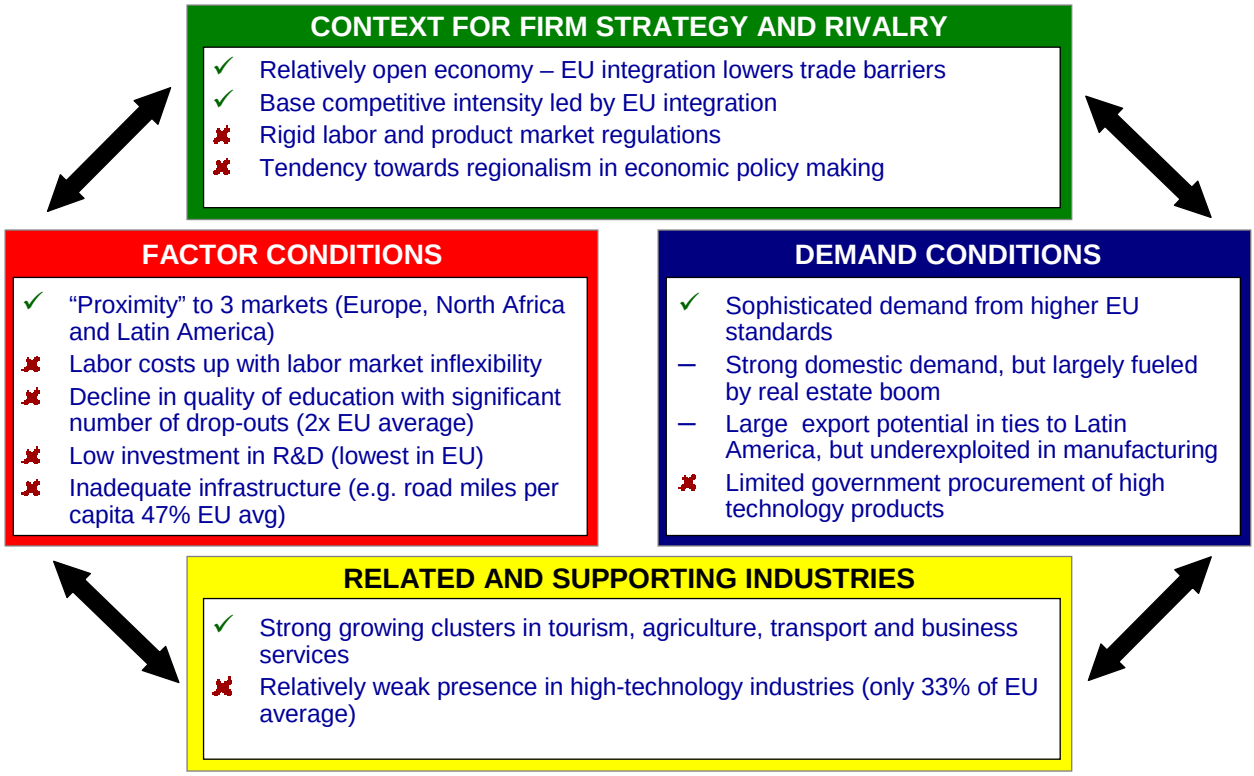
Metric	Metric type	2001	2006	Change
Prevalence of foreign technology licensing	Innovation	15	12	3
Company spending on research and development	Innovation	24	40	-16
Capacity for innovation	Innovation	19	29	-10
Extent of staff training	Management	22	39	-17
Reliance on professional management	Management	16	33	-17
Willingness to delegate authority	Management	25	41	-16
Extent of incentive compensation	Management	13	26	-13
Extent of regional sales	Marketing	26	49	-23
Breadth of international markets	Marketing	22	39	-17
Degree of customer orientation	Marketing	22	33	-11

Source: BCI (2006)

VI b. National Business Environment and the Spanish National Diamond

As discussed above, Spain's business environment has suffered a decline, down to 29 in 2006 from 23 in 2001. The potential strengths and weaknesses of the national business environment can be best understood through the lens of the Spanish national diamond.

Figure 11: Spanish National Diamond



VI b i. Strengths within the Spanish Diamond:

- *Context for Firm Strategy and Rivalry*: The process of EU integration has undoubtedly helped Spain to develop a foundation of competitive intensity in terms of tariff, non-tariff barriers and openness to FDI.
- *Factor conditions*: Spain's geographic location – close proximity to the rest of European markets and North Africa – as well as it strong historic/linguistic ties with Latin America, endow it with a significant advantage in marketing abroad.
- *Related and Supporting Industries*: Spain is actually gaining share in several high growth clusters, notably business services and transportation and logistics, which broadly support other cluster development.[1]

[1] See cluster map above. Spain's market share in business services is up 1.5% since 1997, while transport & logistics is up 0.5% since 1997.

- *Demand conditions*: Finally, Spanish consumer taste and sophistication is easily on par with other EU countries. With the 5th largest economy in Europe and 8.9% of EU population, Spain has a relatively robust foundation of demand.

VI b ii. Weaknesses within the Spanish Diamond

As can be seen in the table below, Spain has suffered weaknesses in each of the diamond areas, with particularly troubling declines in factor conditions and context for firm strategy and rivalry.

Figure 12: Overview of Spain's Competitive Strengths and Weaknesses

Diamond Element	Competitive Strengths	2006	Competitive Weaknesses	2006	Decline last 5 years
Context for Firm Strategy and Rivalry	Centralization of economic policymaking	4	Favoritism in decisions of government officials	53	-39
			Cooperation in labor-employer relations	44	-7
			Efficacy of corporate boards	36	-22
			Effectiveness of antitrust policy	35	-18
			Decentralization of corporate activity	33	-8
			Intensity of local competition	29	-15
Factor Conditions	Air transport infrastructure quality	20	Quality of math and science education	57	-35
	Financial market sophistication	21	Quality of public schools	48	-21
	Reliability of police services	20	Judicial independence	44	-11
	Railroad infrastructure development	18	Quality of scientific research institutions	39	-10
	quality of management schools	13	University/industry research collaboration	39	-9
			Ease of access to loans	37	-14
			Availability of scientists and engineers	37	-11
			Efficiency of legal framework	36	-14
Related and Supporting Industries	Local supplier quantity	16	Local availability of specialized research and trair	37	-22
		30	Local supplier quality	30	-16
		26	Local availability of process machinery	26	-10
Demand Conditions	*None greater than GDP per capita rank*		Government procurement advanced technology p	37	-23
			Stringency of environmental regulations	37	-14
			Laws relating to ICT	31	-8
			Buyer sophistication	27	-4
			Presence of demanding regulatory standards	29	-2

Source: BCI (2006)

- *Factor Conditions*: BCI rankings highlight a particularly steep decline in education related indicators. Spain's ranking in the "quality of math and science education" and "quality of public schools" dropped 35 and 21 places respectively. These indicators are also supported by other empirical data showing that 28% of the total potential labor force has a high school diploma versus 56% for the EU as a whole (Royo, 2006). Such declines could also

ultimately exacerbate the long-run availability of scientists and engineers, which has already fallen by 11 spots to a rank of 37. In addition, as described above, Spain's rigid labor laws have allowed labor costs to rise substantially above new EU entrants. Employee protection provisions have done little to "protect" employees, but have in effect ensured higher rates of unemployment. Firms have generally been discouraged from hiring because they can be forced to pay up to 42 months of severance for laying off employees. This issue has compelled firms to hire more temporary workers (now 30% of the total workforce) which are entitled to only 8 days of severance. In the long-run this "two-tiered system" discourages employee training and lowers overall productivity per worker (OECD, 2007).

Beyond concerns about labor, Spain has also suffered from low rates of R&D investment (the lowest in the EU-15) which in turn helps explain the relatively low ranking of its scientific and research institutions and university / industry research collaboration.

- *Context for Firm Strategy and Rivalry***:** Spain has witnessed a meaningful decline in the general "intensity of local competition," down 15 in the rankings from 2001. Such a trend is evidenced by relatively stringent product market regulations that discourage competition. According to the OECD's product market regulation indicators, two thirds of OECD countries had "a less restrictive stance" than Spain's product market regime (Royo, 2006).
- *Related and Supporting Industries***:** Despite the strong growth in some key clusters, such as business services, the National Business Environment rankings highlight a relative fall in "local supplier quality," as the Spanish SME sector continues to struggle to upgrade its competitiveness.
- *Demand conditions***:** Finally, the national government has lagged in its purchase of advanced technologies as well as in setting sufficiently strict environmental regulations.

VII: GOVERNMENT'S RESPONSE

The Spanish Government has taken initial steps to address those problems through a comprehensive "*National Reform Program*" (European Commission, 2006):

- *R&D* ("*Ingenio 2010"*): This program's goal is to double the civilian research budget by 2010 and stimulate technology transfers by encouraging public/private partnerships.
- *Education*: Increased budgetary resources and greater schools' independence to improve basic education and lower drop out rates. More attention devoted to the evaluation of university performance.
- *Labor market*: Limited efforts to address labor market rigidities between permanent (high protection) and temporary workers.

The pace of reform has been somewhat disappointing to date – the government's agenda is currently dominated by social issues and the regionalization process. On a positive note, the public R&D budget has been increased by at least 25% per year between 2005 and 2007 and the R&D innovation framework has been transformed (see Figure 13 below).

Figure 13: Comparison of R&D Policies

Old R&D Policy	***Ingenio 2010***
Individuals	**Research groups**
Specific projects	**Research lines**
Short term	**Long term**
Low risk commercial research	**Research with more commercial risk**
Limited private partnership	**Strong private partnership**
Ex-ante evaluation	**Ex-ante, intermediate and ex-post evaluation**

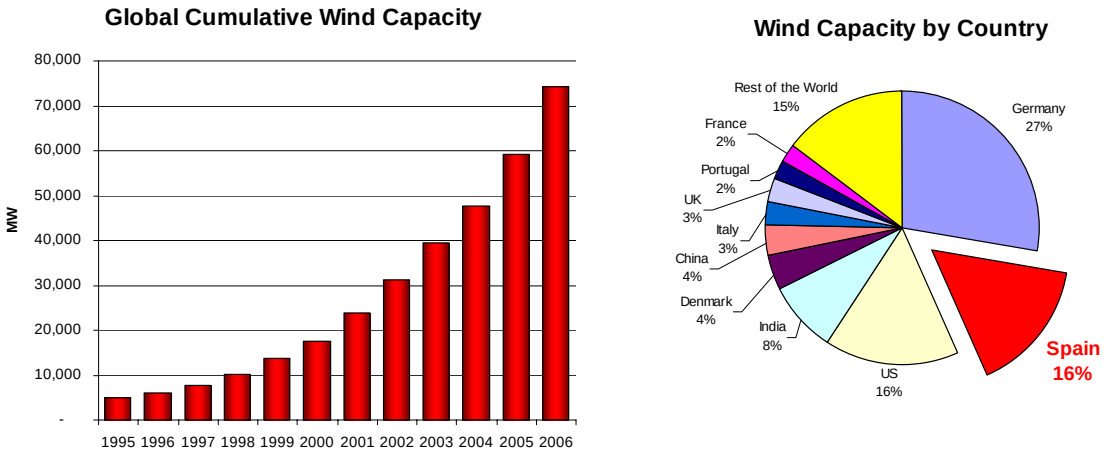
CLUSTER ANALYSIS

VIII. THE GLOBAL WIND POWER MARKET

The global wind power market is comprised of the set of companies and institutions which, in concert, result in the generation of electricity from the harnessing of wind energy. The activity chain is robust from start to finish. It includes land attainment, wind measurement, turbine procurement, permitting and installation, and operation and maintenance of wind farms. The development of wind turbines and their subcomponents requires substantial and continuous investment in R&D. Indeed, over the past 20 years, wind turbines have increased in power by a factor of 100 (EWEA, 2006).

Global demand for wind energy has increased just as dramatically, particularly since the adoption of the Kyoto Protocol. Worldwide installed capacity has increased from 7,600 MW in 1997, when the Protocol was adopted, to 74, 223 MW in 2006.[2] Spanish wind farms account for 15.6% of the global total, placing the country second only to Germany in terms of installed capacity.

Figure 14: Installed Capacity Globally and by Country



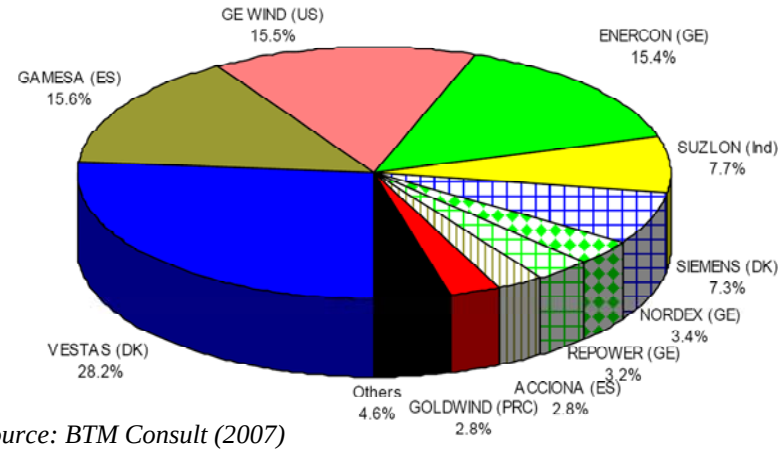
Source: Global Wind Energy Council (2006)

[2] See the February 2, 2007 press release from the Global Wind Energy Council at http://www.gwec.net/uploads/media/07-02_PR_Global_Statistics_2006.pdf.

Spain has developed one of the world's most significant wind clusters, including several players which have grown to become international players. Spain's primary competitor in the cluster is Denmark, home to Vestas, the world's largest wind turbine manufacturer with 28% market share (see Figure 15). Furthermore, Denmark boasts a 93% market share in the growing offshore wind segment (DWIA, 2005). However, Denmark's domestic wind market is closer to its technical potential at 23% of total electric capacity, vs. 13% for Germany and 12% for Spain (Eurostat, 2006).

The United States and Germany are also leaders in wind power development, as shown in Figure 15. The Indian firm Suzlon is growing rapidly, with sales expanding of 114% in the past year (Suzlon, 2007).

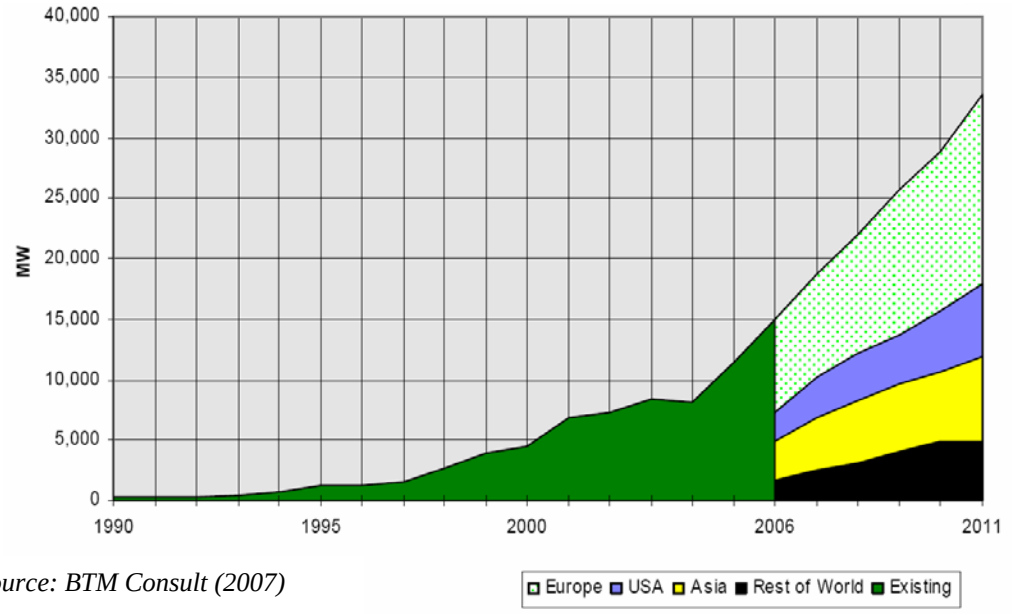
Figure 15: Global Turbine Market Share



Source: BTM Consult (2007)

Looking forward, a greater proportion of new turbine installations are expected to be located outside of the European and

Figure 16: Global Turbine Installations and Forecast

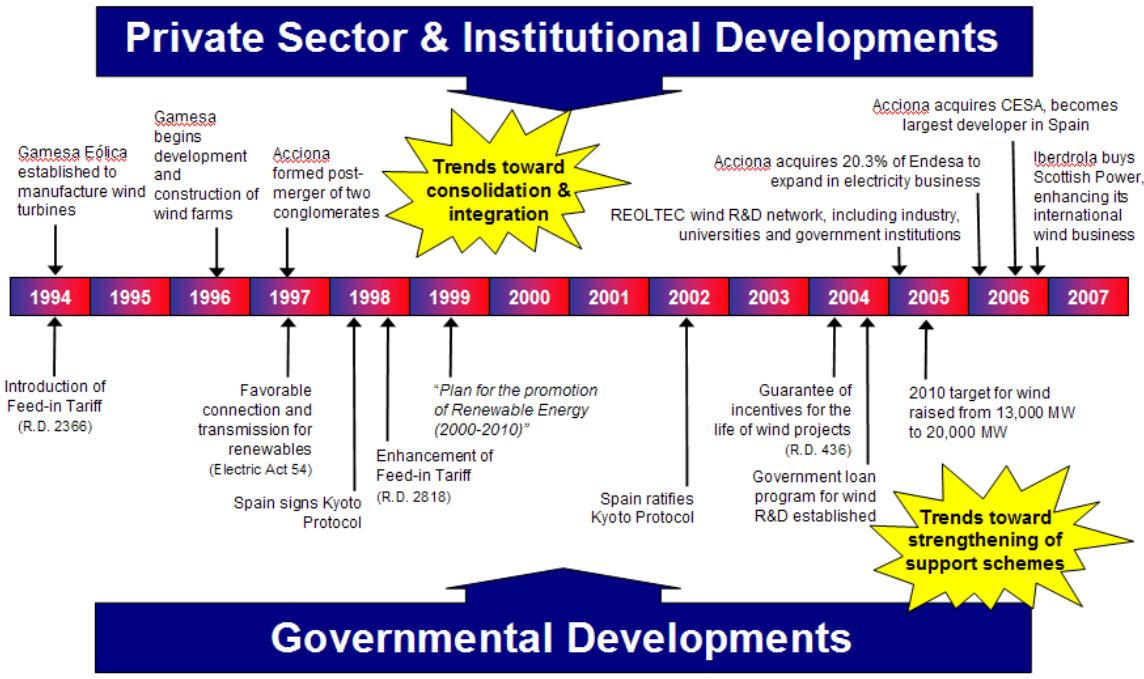


Source: BTM Consult (2007)

American markets. However, Europe and America are expected to provide the bulk of growth over the next five years, as show in Figure 16.

IX. THE EMERGENCE OF A WIND POWER CLUSTER IN SPAIN

Figure 17: Cluster Timeline



Source: Gamesa, Acciona annual reports; MOC team

Although windmills have been familiar sights in Spain since at least the time of *Don Quixote* in 1605, the modern wind industry began in 1994 with the introduction of the first special feed-in tariff for wind power. The Spanish government has continually strengthened support schemes for wind power, including feed-in tariffs (the second highest in Europe at 9.20 €¢ / kWh), lower tax rates (10% vs 35%), soft loans, and regional investment subsidies (EWEA, 2005). Spain was one of the first EU nations to establish an explicit renewable energy target in 1999, and recently announced an aggressive plan to double wind output by 2010. Kyoto protocol commitments to reduce CO_2 at both the EU and national level have also provided strong support the industry.

While wind power currently needs subsidies to compete with fossil-fueled electricity generation, it is the least expensive renewable energy source that can be deployed at large scale today. Furthermore, many experts believe that wind power is less expensive than fossil-fueled generation when the full environmental externalities of these sources are included. Spain has seized on these arguments in pushing its renewable energy programs, which are considered to be more stable than those of other European countries.

For Spain, wind power is especially important given the country's high reliance on imported energy sources. Spain's total primary energy needs grew 50% between 1990 and 2002, while domestic energy production remained roughly flat over the period. Spain imports 75% of its total primary energy needs, or 87% if nuclear is counted as an imported fuel. Furthermore, Spain's main supplier of natural gas is Algeria, which has exhibited worrisome signs of political instability in recent years. Wind power is helping Spain to reduce this dependence on foreign energy. The early results of this strategy are indeed encouraging, as Spain has been a net electricity exporter to France, Portugal and Morocco in recent years (IEA, 2005).

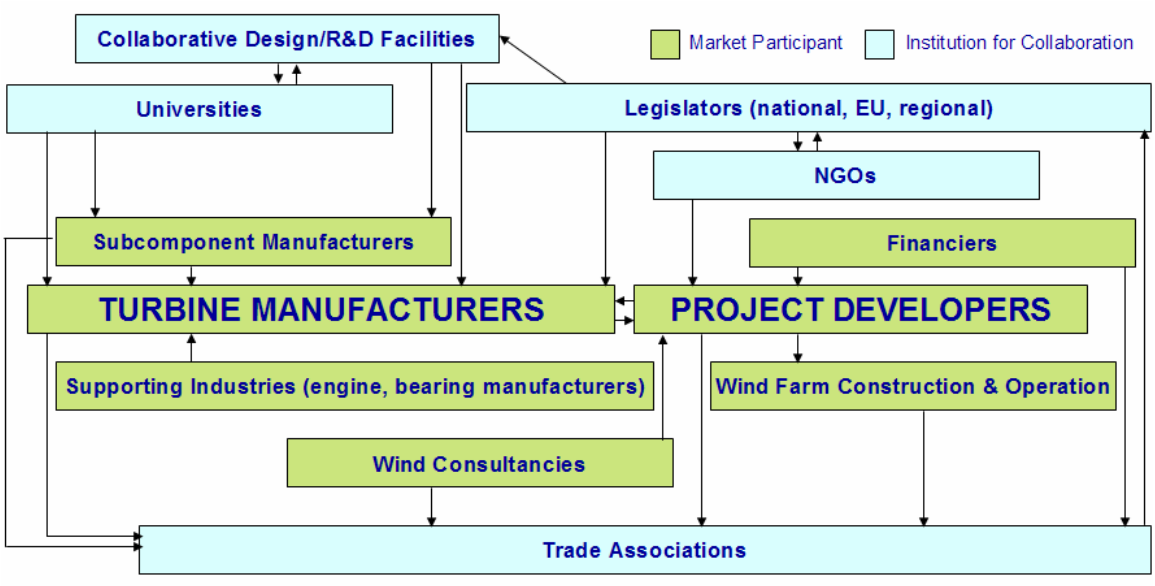
X. THE SPANISH WIND POWER CLUSTER

X a. Overview

In aggregate, the Spanish wind power cluster netted revenues of €20 billion in 2005. (IEA, 2006). Over 300 companies participate in the cluster, generating over 31,600 jobs related to wind power (Cena, 2007). Figure 18 illustrates the grouping by activity of the various cluster actors, with arrows indicating which activities flow into others. Two sets of actors are particularly central to the cluster's development — turbine manufacturers and wind farm developers. Especially in recent years, wind farm development has been dominated by major utilities such as Acciona, Iberdrola, and Endesa. Historically, these utilities fulfilled their renewable obligations by purchasing wind power output from a diffuse and regionally fragmented group of independent developers. However,

the emergence of large-scale wind farms lent itself to consolidation, and utilities have since discovered that their expertise in generating and overseeing the offtake of power lends itself well to operating farms directly. Of the turbine manufacturers, Gamesa is far and away the leader with a market share exceeding 54% in Spain and global market share of 16%, rendering it the second largest turbine manufacturer in the world (BTM Consult and Gamesa, 2007). The remainder of the Spanish market is split among foreign and domestic manufacturers including Ecotecnia, which also ranks among the world's top ten manufacturers. Supporting industries such as engine and bearing manufacturers are grounded in Spain's historical strength as an automobile and aircraft production site.

Figure 18: Cluster Map



Source: MOC team

X b. Performance

The companies comprising the Spanish wind power cluster have experienced tremendous growth in the last few years, mostly due to their ability to capitalize on rapidly expanding, legislative-driven global demand. Indeed, in 2005, Ernst and Young placed the Spanish wind market at the top of its long-term country attractiveness index as assessed by their Renewable

Energy Group (Graber, 2005). Because the Spanish wind power cluster was one of the world's first to develop, Spanish firms have benefited from an especially long history with wind power and from an array of R&D innovations and support networks.[3] The three following organizations are representative both of cluster performance and of the trends Spanish wind power companies are experiencing.

Gamesa: World's #2 Turbine Manufacturer

Over the past 15 years, Gamesa has evolved from a diversified manufacturer of aircraft and machinery into the world's #2 wind turbine manufacturer with revenues of €1.7 billion (Gamesa, 2006). Gamesa's two business segments include Gamesa Eolica (turbine manufacturing) and Gamesa Energia (wind farm development – a new and growing business). Its business is truly global, with nearly half of revenues generated outside of Spain and a 16% share of the global turbine market. Gamesa has used its 150-person internal R&D department to move up the value chain into higher margin blades and software, while outsourcing certain lower-value products such as tower manufacturing.

Acciona: World's #1 Wind Farm Developer

Acciona built its position as the world's #1 wind farm developer primarily through the Spanish domestic market, but is now rapidly expanding with projects overseas. The firm has operations in 33 countries worldwide, with two plants in Spain and one in China to serve its backward-integration into turbine manufacturing. Acciona's revenues of $6.2 billion are led by the Acciona Energia unit, which experienced 60% growth from 2005 to 2006. Other businesses include infrastructure, real estate, transport, housing and water.

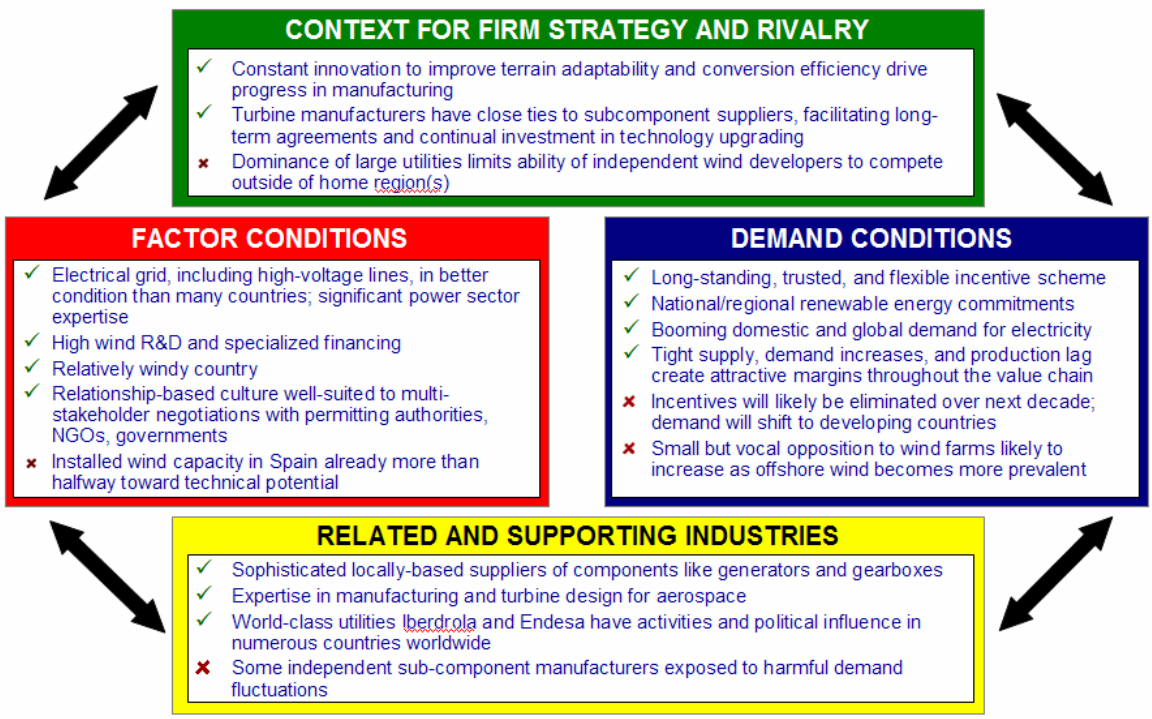
[3] A good example would be the fact that Gamesa has developed a recognized expertise in designing turbines which can be used in "difficult terrains"; this capability emerged in response to the fact that some of the windiest areas in Spain were also extremely hilly.

REOLTEC: R&D Institution

REOLTEC is a collaborative institution which has worked to coordinate R&D between 39 firms, foundations, national laboratories, and universities. The institute organizes conferences, government lobbying and seminars, while representing cluster interests to the EU and to the national government. Key initiatives include standardization and certification, minimizing the environmental impact of wind farms, grid integration, offshore development, and site wind resource assessments (Cena, 2007).

XI. SPANISH WIND POWER CLUSTER COMPETITIVE CONTEXT

Figure 19: Cluster Diamond



Source: MOC team

Factor Conditions

Spain has wind resources that are comparatively moderate, with many good resources in challenging, hilly terrain (see Figure 20). The success of Spanish manufacturers and developers in

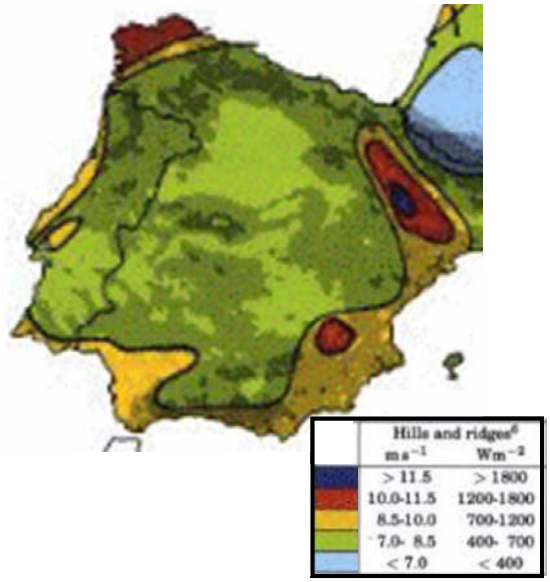
these areas has provided exportable skills to tackle challenging terrains in other nations. This dynamic provides a potent illustration of Porter's contention that "selective disadvantages in the more basic factors can prod a company to innovate and upgrade – a disadvantage in a static model of competition can become an advantage in a dynamic one" (Porter, 1998). Other factor conditions important to the cluster include a well developed electrical grid, high levels of expenditure on wind-related R&D and expertise in financing wind power projects. Furthermore, Spain's relationship-based culture is well suited to multi-stakeholder negotiations with permitting authorities, utilities, and NGOs. The Spanish language has aided companies with international expansion in Latin American nations.

As will be later discussed in the Strategic Issues section, the current penetration of wind power in Spain is currently over halfway towards its technical potential. This technical potential is based on site availability and the intermittent nature of wind, which makes scheduling of power flows difficult. Two technologies that could overcome these factor condition limitations are inexpensive electricity storage (which would enable wind farms to sell "firm" power output) and offshore wind farms (which overcomes onshore site availability constraints). A bill has recently been introduced to speed development of offshore wind farms in Spain (AFP, 2007).

Demand Conditions

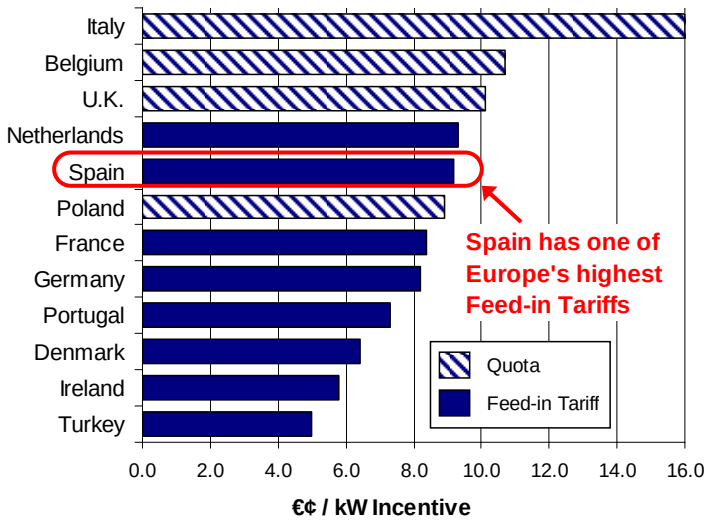
As discussed above in *The Emergence of a Wind Power Cluster in Spain*, government support through the feed-in tariff (see Figure 21) and other measures has been essential in kick-starting domestic demand for wind power. Spain has a national goal of doubling domestic wind power by 2010 (IEA, 2006), providing near-term demand certainty. However, the industry may face an eventual decline in domestic demand as incentives are phased out. Globally, demand is expected to surge in coming decades for the use of electric power generally and renewable resources such as wind specifically.

Figure 20: Spanish Wind Map



Source: BP (2006)

Figure 21: European Wind Incentives



Source: Emerging Energy Research (2006)

New productive capacity in the wind industry supply chain has historically been tempered by reliance on government incentives (which are often only guaranteed for a few years into the future). This tight supply chain, coupled with booming demand, has lead to shortages in many components such as gearboxes and bearings (Aubrey, 2007). Spanish turbine manufacturers, who tend to be more vertically integrated than their competitors, have benefited from this trend.

Related and Supporting Industries

An historical Spanish strength in manufacturing of automobiles and aircraft has greatly aided the development of the wind power cluster. A skilled base of aeronautical engineers, materials scientists, software programmers, process design specialists, and mechanical engineers have enabled the Spanish wind industry to focus on higher value-added activities (such as blade design, software programming and gearbox manufacturing). The Spanish utility industry has also played a key role in international expansion, building on their relationships with utilities and government in foreign nations.

Context for Firm Strategy and Rivalry

The constant drive for innovation to improve terrain adaptability and overall efficiency has increased competition in many sectors of the wind value chain. Spanish manufacturers have had to compete against with larger, older Danish manufacturers in the European market, and are now facing challenges from lower-cost EU nations such as Hungary and emerging market economies such as India. The Spanish cluster has performed remarkably well against these challengers, both in the domestic market and abroad. This has been aided by the turbine manufacturers' close ties to subcomponent suppliers, facilitating long-term agreements and continual investment in technology upgrading.

XII. STRATEGIC ISSUES FACING THE CLUSTER

Challenge**:**

- ✘ Installed wind capacity in Spain already more than halfway toward technical potential.
- ✘ Incentives will likely be eliminated over next decade; demand will shift to developing countries

RESPONSE: Internationalization[4]

Internationalization means different things to different participants of the Spanish wind cluster. For the wind farm operators, comprised primarily of large Spanish utilities, the construction and operation of wind farms abroad is essentially an extension of their previous power generation mix. Companies such as Endesa and Iberdrola have invested in subsidiaries throughout regions such as Latin America for years. For instance, Endesa first entered Latin America in 1992, and by 2001 controlled 12.4 GW of generating capacity, rendering it the leading private–sector electricity multinational in the region (Chislett, 2002). Iberdrola participates in the management of 26

[4] For company specific information about the internationalization of firms in the Spanish wind cluster, see information posted on their individual websites such as the chapter on China located at http://www.gamesa.es/gamesa/modules/idealportal/uploadlink/Agreement%20in%20China.pdf and the chapter on the United States located at http://www.gamesa.es/gamesa/modules/idealportal/uploadlink/ContractwithHorizonWind.pdf.

companies in Brazil, Mexico, Bolivia, Chile, Guatemala and Uruguay and is also the leading independent generator of electricity in Mexico.

For turbine manufacturers, internationalization has been a means of accessing new markets for turbine supply and, increasingly, for forward integration into wind farm development. For example, turbine manufacturer Ecotecnia recently stated that in 2007, the company plans to build 17 wind farms, 54 percent of which will be located abroad.[5] Ecotecnia and Gamesa have adopted primarily two tactics in their international expansion. The first is straight-forward approach to deal-making, e.g. "You provide me with permits to build wind farms, I'll bring the turbines." The second is a more indirect form of lobbying foreign governments to obtain land and permits, including 1) joint ventures with local firms, 2) the promise of job creation through the building of new factory, and 3) development work, especially in poorer areas.

Gamesa: A Case Study in Internationalization

As the Spanish market has become more saturated and as global demand has increased, Gamesa has embraced internationalization. In 2005, Gamesa consolidated its position in China with the construction of a €60 million wind turbine assembly plant located in Tiajin province. The company has since signed five contracts worth €160 million to supply subsidiaries of the China Long Yuan Electric Power Group with turbines. With a 2004 market share of 37%, Gamesa is now the #1 turbine manufacturer in China. The newly passed Chinese Renewable Energy Law doubled the government target for wind to 40,000 MW by 2020, suggesting that demand growth will accelerate even further. In the United States, Gamesa has signed a $700 million agreement to provide wind developer Horizon Wind with 600 MW of turbines in 2006 and 2007, bringing Gamesa's total contracts in the US to 1,214 MW and lifting the capacity utilization of its US production plant to 100%. In addition, the company also has operations in France, Italy, Greece, Portugal, Germany, and Brazil.

[5] See the article entitled "Ecotecnia Aims for International Expansion on its 25th Anniversary" at www.ecotecnia.com.

Challenge:

- ✘ Due to long lead-times in capacity expansion, some independent sub-component manufacturers exposed to harmful demand fluctuations.

Response: Integration

Wind turbines are comprised of many highly specialized subcomponents. The global wind power industry is currently facing major turbine supply shortages, a condition expected to remain through 2009 (BTM, 2007). These shortages are in response to two factors: a 40% annual increase in global demand for turbines, and the long lead times necessary for subcomponent manufacturers to increase capacity. The resultant tightness in the supply chain has forced greater vertical cooperation and planning among players.

Spanish subcomponent manufacturers have faired well due in some part to institutions for collaboration such as REOLTEC, which have fostered cross-company relationships and information exchange. Producers of blades and gearboxes have benefited from their close ties with turbine manufacturers because these long-term relationships have given them the confidence to expand production. "Insufficient communication between the different players," a problem which the European Wind Energy Association notes as an obstacle to integration in other countries, is not an issue in Spain. Spanish manufacturers are also relatively well-positioned because of a related trend toward larger, more powerful turbines. To remain on the cutting-edge of turbine manufacturing, companies such as Gamesa rely upon sophisticated subcomponent suppliers. The existence of top-tier suppliers in Spain has been a major enabler of Gamesa's growth. By contrast, Indian upstart turbine manufacturer Suzlon has been forced to make expensive acquisitions abroad in an attempt to access subcomponents.[6]

[6] For example, on March 17, 2006, Suzlon acquired Belgian gearbox manufacturer Hansen Transmissions for $565 million in an all-cash transaction.

XIII. POLICY RECOMMENDATIONS

XIII a. National Level Recommendations:

As discussed above, Spain recognizes its failings but has generally made slow progress. There are three areas on which Spain must focus to regain its competitiveness stature in the coming years.

- *Labor market***:** Spain must make strides towards opening its labor markets. To offset the loss of its "cost advantage" it must work to relax laws which inhibit the hiring and firing of workers. In effect, the country will need to rationalize the two-tiered system in which firms opt for more temporary employment so as to avoid onerous redundancy/severance payments. This in turn will require the government to encourage unions to allow for a more flexible approach to wage negotiation.
- *Innovation:* Spanish small and mediums enterprises (SMEs) are a critical component of the corporate sector. Yet, they lack the capacity and scale to ensure higher levels of investment in research and development. To address this we recommend that the government help establish institutions for collaboration focused on R&D for SME's. The national government could then provide tax credits and subsidies to those SME's that made the effort to pool their R&D initiatives.
- *Education:* Finally our analysis suggests that the Spanish basic and higher education systems are simply not sufficient to support on-going innovation in the economy. For instance, universities should be given greater flexibility (budget, curriculum and faculty) in order to rise to the challenge of the Bologna process. To address this, the government must boost investment in basic education, particularly in math and science.

  In addition, the government should consider providing tax credits to firms that assist in establishing cluster-specific education initiatives. Government should reach out to firms

in high value / high growth clusters (including banking, telecoms, and autos) to help establish cluster-specific institutes that would train workers for a variety of roles within the industry.

XIII b. Cluster Level Recommendations:

Domestic

At a domestic level, Spain can enhance long-term predictability regarding wind subsidies and tariffs through long-term legislative guarantees. Predictability is essential if Spanish firms are to increase investment in productive capacity to serve the domestic market. Furthermore, Spain must boost R&D investment and foster inter-organizational collaboration for critical enabling technologies such as low-cost electricity storage and offshore wind platforms. Floating turbine platforms could open up many of Spain's coastal basins that are significantly deeper than current offshore sites (such as those in Demark).

International

At the international level, Spain can promote policies that will boost demand for renewable energy and directly create markets for the Spanish wind cluster. For example, Spain should lobby for an enhanced renewable energy credit program for European and global CO_2 abatement programs. Furthermore, the massive market potential of emerging economies can be tapped through policy advisory, conferences on wind technology, and development assistance tied to renewable energy programs.

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Web Resources to Learn More

AEE (Spanish Wind Energy Association)
www.aeeolica.org

APPA (Association of Producers of Renewable Energies)
www.appa.es

CIEMAT (Center for Research in Energy, the Environment, and Technology)
www.ciemat.es

REOLTEC (La Red Científico Tecnológica del Sector Eólico)
www.reoltec.net